traveler **44** using adjustment tool **53**. During that procedure optic **43** also rotates. When the spherical power has been adjusted properly, adjustment tool **44** is used to rotate optic **43** and its optic flange **46** inside groove **47** of traveler **44**. Optionally, calibration markings may be incised upon optic flange **46** to assist in achieving the proper angular orientation of optic **43** for astigmatic correction. During adjustment of spherical power the change in cylindrical power will be negligible.

It will be appreciated that rotation of the optic and traveler of this embodiment also can be accomplished by laser radiation applied to vanes affixed to the optic and traveler, as disclosed above in connection with the embodiments of FIGS. **10–14**. Further, a pair of micromotors and belts also could be used to adjust for focus and astigmatism.

Intraocular Lens Assembly Using A Fluid- Or Gel-Filled Optic Or Optics

When a soft, foldable optic of constant shape that is made of silicon or other appropriate material is used, as in the foregoing embodiments, about 4 mm of axial travel is needed to provide reasonable range of adjustment of spherical power. Thus, the IOL assembly must be somewhat more than 4 mm thick at its thickest point along the optical axis.

A flexible optic filled with transparent, incompressible fluid having a high index of refraction can be used in an embodiment that allows the overall assembly to be much thinner. As shown in FIG. **21**, the fluid-filled lens **62** is fitted with a flange **63** that engages a spiral helical groove **64** of varying diameter. The aperture in the haptic that accommodates the groove is generally frusto-conical in shape, seen in cross-section. As the optic is rotated using any of the techniques and devices described above, the spiral helical groove **64** forces the flange **63** inward or allows it to expand outward. Since the optic comprises a fluid contained in an elastic bag, the radius of curvature of the optic then changes in response to the change in diameter of the spiral helical groove. For example, in a typical eye, an 0.5 mm decrease in diameter of the fluid optic can decrease the radius of curvature by about 2.5 mm, thereby increasing the power by more than 5 diopters. Thus, a given change in power can be accomplished within a much smaller axial movement, since the effect of change in curvature is more efficient, and can be made in addition to translational effects. Alternatively, a conical groove may be used, in which circular grooves are nearly confined to a plane but allow for a sharp curved transition to the next nearly circular groove of lesser diameter. The optic shape and power thus changes in discrete steps as the optic is rotated.

Another, alternate embodiment of our invention using a fluid-filled, deformable optic is shown in FIGS. **22–24**. In this embodiment, the fluid-filled optic **66** moves along an elliptical spiral helical groove **67** (see FIG. **23**) in which the major axis (long axis) is held constant while the minor axis (short axis) is allowed to increase or decrease with the axial movement of the optic along the groove. The cylinder power of the astigmatic correction provided by the optic is thus made to vary since the radius of curvature of the optic is changing in one direction and not the other. In connection with varying the cylinder power of the astigmatic correction by ±1 diopter, the spherical equivalent of the optical surface will change by only ±0.5 diopters. (This change can be counteracted by translation to keep the spherical power approximately constant.)

In this embodiment, provision is also made to allow circular rotation of the entire elliptical helical groove **67** by the addition of a sleeve **68** within the haptic body. The sleeve contains the groove **67** and is allowed to rotate independently within the haptic **69**, thereby allowing for adjustment of the angular orientation of the astigmatic correction once the cylinder power is properly set.

In still another embodiment using two fluid-filled optics (see FIG. **24**), the haptic **70** is provided with a central aperture divided into a first portion **71** featuring a spiral helical groove **72** of progressively diminishing diameter, and a second portion **73** with an elliptical helical groove **74** of progressively decreasing minor and constant major diameters. First, focusing optic **75** moves within the spiral helical groove to alter the spherical power of the assembly, while second, toric optic **76** moves within the elliptical helical groove to adjust astigmatic correction. Manual adjustment using a tool(s) inserted through the paracentesis incision(s) at the corneo-scleral limbus; laser adjustment or micromotors can be used to rotate the optics.

Embodiments Using Twin Curved Haptics

The preceding embodiments have been described as using a single, oval-shaped foldable haptic having a substantially flat or preferably lozenge-shaped profile. FIG. **25** illustrates an alternative embodiment for postoperative adjustment of astigmatic correction that uses a pair of thread-like, curved haptics **77**, **78** attached at 180° opposed locations to the exterior surface of a generally toroidal ring **79**. (Designs using two separate, curved haptics now account for the majority of sales of all IOL's.)

Toroidal ring **79** comprises a groove **80** on its inner surface to accommodate flange **81** of toric lens **82**, which is generally sphero-cylindrical in shape. FIG. **27** shows a T-shaped groove, but it will be understood that grooves of other shapes, as disclosed above, also could be used. Rotation of lens **82** can be accomplished manually or by use of a laser as disclosed above.

In still another alternate embodiment, toroidal ring **79** is thicker along the axis of the eye to accommodate a helical groove. This embodiment enables adjustment of power.

Those of ordinary skill will understand from the foregoing disclosure that many other embodiments can be created that utilize the features of our invention. We intend, therefore, to incorporate all such alternate embodiments and to limit our invention only as set forth in the following claims.

We claim as our invention:

1. An intraocular lens assembly comprising:
   a. a foldable haptic, said haptic having a substantially planar body and having a substantially circular central aperture;
   b. a groove in said haptic around said central aperture in the plane of said haptic;
   c. a foldable optic having a circular shape with an exterior periphery and a conformation suitable for correction of astigmatism, sized to fit within said central aperture;
   d. a foldable flange surrounding said exterior periphery of said optic and extending outward therefrom to operatively engage said groove;
   e. said optic manually rotatable within said haptic; and
   f. an attachment member affixed to said flange, said attachment member facilitates said manual rotation of said optic within said haptic to accomplish adjustment of astigmatic correction.

2. The intraocular lens assembly of claim 1 wherein said attachment member is a depression.

3. The intraocular lens assembly of claim 1 wherein said attachment member is a loop.

4. The intraocular lens assembly of claim 1 wherein said flange is generally T-shaped in cross section.

5. The intraocular lens assembly of claim 1 wherein said flange further comprises in cross-sectional view a straight portion and a circular portion separated from said periphery of said optic by said straight portion.

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